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ENTATION E

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION US Army Research Institute of Environmental Medicine 6b. OFFICE SYMBOL (If applicable) SGRD-UE-H:	7a. NAME OF MONITORING ORGANIZATION US Army Medical Research and Development Command
6c. ADDRESS (City, State, and ZIP Code) Natick, MA 01760-5007	7b. ADDRESS (City, State, and ZIP Code) Ft. Detrick, Frederick, MD 21701-5012
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Same as 6a. 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Same as 6c.	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 63002D PROJECT NO. 3M2630-02D995 TASK NO. AE WORK UNIT ACCESSION NO. DA 305221

11. TITLE (Include Security Classification)
Subjective Reactions to Atropine/2-PAM Chloride and Heat While in Battle Dress Uniform and in Chemical Protective Clothing

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13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Manuscript	FROM _____ TO _____	Mar 1989	29

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Drug, Heat, Atropine, Pralidoxime, 2-PAM chloride, Chemical protective clothing, MOPP, BDU, Mood, POMS, ESQ, BSRS

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL John L. Kobrick	22b. TELEPHONE (Include Area Code) 508-651-4885 22c. OFFICE SYMBOL SGRD-UE-HP

DD Form 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE

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Running head: SUBJECTIVE REACTIONS TO ATROPINE/2-PAM AND HEAT

Subjective Reactions to Atropine/2-PAM Chloride and Heat While In Battle Dress Uniform and In Chemical Protective Clothing

Abstract

Subjective reactions and symptomatology were assessed during continued exposure to combinations of atropine (2 mg) and 2-PAM chloride (600 mg), heat/humidity (95°F/60%RH), and wearing either the US Army battle dress uniform (BDU) or impermeable chemical protective clothing (MOPP-IV). Reported symptoms were due primarily to heat rather than to drug, but some visual and somesthetic reactions typical of atropine were also noted. Elevated heat stress caused by wearing MOPP-IV at 95°F/60% RH significantly increased the frequency and severity of reported symptoms, compared to a parallel study under equivalent heat conditions but while wearing only BDU's. In the heat condition, subjects were able to complete all six hours of testing when wearing BDU's, but only lasted two hours in MOPP-IV. Claustrophobic reactions due to encapsulation in MOPP-IV reported in other studies were not observed.

Subjective Reactions to Atropine/2-PAM Chloride and Heat While In Battle Dress Uniform and In Chemical Protective Clothing

The possibility of nerve agents being deployed in future warfare has led the US armed services to develop means for effective protection and treatment of military personnel in case of such exposure. The current US armed forces nerve agent antidote is atropine sulfate (atropine) (in 2 mg dose units) and pralidoxime chloride (2-PAM) (in 600 mg dose units) administered by paired intra-muscular injections. Although these drugs provide good physical protection, they also have side effects which could lead to adverse subjective reactions and impaired performance (O'Leary, Kunkel, & Jokes, 1961; Taylor, 1980; Vojvodic & Boskovic, 1974).

The major physiological reactions to atropine alone (Calesnick, Christensen, & Richter, 1967; Cullumbine, McKee, & Creasey, 1955; Marzulli & Cope, 1950), and in combination with heat stress (Kolka, Holden, & Gonzalez, 1984; Kolka, Stephenson, & Gonzalez, 1986; Kolka, Stephenson, Bruttig, Cadarette, & Gonzalez, 1987) have been identified. However, effects on psychological, perceptual and cognitive behavior are less clear, although some performance-oriented studies have been reported (Baker et al., 1983; Moylan-Jones, 1969; Penetar & Henningfield, 1986; Wetherell, 1980). The physiological effects of 2-PAM alone and in combination with atropine have also been studied (Holland, Kemp, & Wetherell, 1978; Robinson & McMichael, 1970), but much less is known about associated psychological and perceptual effects (Haegerstrom-Portnoy, Jones, Adams, & Jampolsky, 1987; Headley, 1982), even though such knowledge is essential in view of their paired use as the standard nerve agent antidote.

Chemical warfare in tropic and desert areas will cause other problems in

using nerve agent antidotes, stemming from the prevailing hot or hot-humid conditions. The levels of heat stress under such conditions will become even more severe when troops have to wear chemical protective clothing, specifically, the Mission Oriented Protective Posture (MOPP) ensemble. Based on a modular concept, this system provides successively greater degrees of chemical protection through increased levels of encapsulation, termed MOPP-I, -II, -III and -IV. At MOPP-IV involving total encapsulation, heat and body moisture trapped inside the ensemble rapidly accumulate and interfere with performance, even under cool ambient conditions. When the MOPP system is worn in a hot environment, these problems increase significantly.

It is conceivable that chemical threats could occur in which personnel would also self-administer nerve agent antidote while wearing the MOPP system; e.g., surprise attacks, premature injection by mistake, or physical damage to the MOPP ensemble sufficient to break encapsulation. In such situations, troops would be subjected to a greatly increased heat/humidity stress load combined with the effects of drug antidote. On the other hand, situations could occur involving atropine/2-PAM administration in the heat, but in which personnel would be wearing only the battle dress uniform (BDU), the current field uniform. There are virtually no systematic data suitable for making overall comparisons of subjective and psychological reactions under the various combinations of these circumstances.

In order to obtain such information, a study was recently conducted to systematically assess both the separate and combined effects of heat exposure, standard atropine/2-PAM dosage, and wearing of both the BDU and MOPP-IV clothing ensembles on a variety of psychological, rational and cognitive tasks involved in military performance. The overall project consisted of two

separate studies which were identical except that in one study the subjects wore the BDU ensemble, while in the other study the subjects wore MOPP-IV. For a condensed summary of this project, see Kobrick, Johnson, & McMenemy (1988). The present paper gives a detailed overall review of the symptomatic, mood and subjective reactions which occurred.

Study 1. Effects of Atropine/2-PAM and Heat on Symptomatic, Mood and Subjective Reactions While Wearing the BDU Ensemble

Method

Subjects

Fifteen male soldiers, ages 18-32, were screened medically, and were tested for normal vision and hearing. They were briefed on the nature of the study and its potential hazards, and then read and signed a volunteer agreement of informed consent before being allowed to participate.

Procedure

The subjects were trained intensively six hours daily for five consecutive days on a group of performance tasks related to military activities. Thereafter, they performed the tasks on four separate test days, each day corresponding to one of the following experimental test conditions: (1) control (saline placebo; 70°F, 30% RH); (2) drug only (2 mg atropine sulfate, 600 mg 2-pam chloride; 70°F, 30% RH); (3) ambient heat only (saline placebo; 95°F; 60% RH); (4) drug and ambient heat (2 mg atropine sulfate, 600 mg 2-PAM chloride; 95°F, 60% RH). On each test day, subjects received either the assigned combination of atropine and 2-PAM or equivalent volumes of saline placebo, injected into the thigh muscle by 22-gauge syringes. Atropine was administered by one injection, but since 2-PAM causes discomfort at the injection site the required 600-mg dose was divided into two 300-mg units,

one injected into the thigh muscle of each leg. Drug conditions were assigned on a double-blind basis; however, for safety reasons, a medical monitor presiding over the study knew the identities of both drug and placebo subjects. Test days were separated by at least three days off to insure adequate recovery from the preceding drug conditions. Testing began each day approximately 30 minutes after drug administration.

All subjects were targeted to complete three performances of the total cycle of tasks on each testing day, and continued to perform until the point of either voluntary withdrawal or mandatory removal by the medical monitor for exceeding medical safety criteria (pulse rate of 160 bpm or higher for five minutes continuously, and/or, rectal temperature exceeding 102.2°F. (39°C.)). The three testing cycles were begun at standard 2-hour intervals in order to maintain overall uniformity of daily heat exposure. Subjects were allowed to drink water ad lib from standard military canteens; however, lunch and snacks were omitted.

Three paper-and-pencil tests were administered periodically during the course of each experimental session: (1) the USARIEM Environmental Symptoms Questionnaire (ESQ) (Kobrick & Sampson, 1979); (2) the Profile of Mood States (POMS) (McNair, Lorr, & Droppelman, 1981); and, (3) the Brief Subjective Rating Scale (BSRS) (Johnson, 1981).

The ESQ is a self-rating inventory designed to sample subjective reactions and medical symptomatology of individuals during exposure to environmental and other stressors. It contains 68 statements describing various symptomatic reactions which the respondent rates as to experienced severity on a scale of 0 through 5. The POMS is a factor-analytically derived rating scale consisting of 65 items intended to assess six mood states

(tension, depression, anger, vigor, fatigue, confusion). The BSRS is designed to quickly appraise subjective feelings of warmth, comfort and tiredness on separate rating scales by selection of descriptive words or phrases. Warmth is rated on a 7-point scale; discomfort and tiredness are each rated on 4-point scales.

The ESQ and POMS were each administered once at the termination of each daily session to survey individual subjective reactions, feelings and temperament patterns during exposure to the experimental conditions. In addition, the BSRS was administered once at the beginning of each session (30 minutes post-injection) and then once at the end of each of the three cycles within the session (150, 270 and 390 minutes post-injection).

Results and Discussion

Environmental Symptoms Questionnaire (ESQ)

In order first to survey the overall incidence of reported symptoms, the group mean ratings for each of the 68 ESQ items were calculated for each of the four test conditions (70°F/placebo; 70°F/drug; 95°F/placebo; 95°F/drug). The separate ESQ items were then arrayed sequentially in descending order of group mean rating magnitude for the 70°F/placebo condition, on the assumption that this array represented the most likely order of relative frequency of symptom occurrence under optimum test conditions. The mean rating values were then arrayed for the other three test conditions, but using the same order of ESQ items as for the 70°F/placebo condition. This arrangement is summarized in Table 1, along with short statements of the respective ESQ items.

Insert Table 1 about here

Note that all rating values are shown for 70°F/placebo, the optimum comparison condition. However, for simplicity only values of 1.00 or more are shown for the other three stressful test conditions.

An overall comparison of the ratings in Table 1 shows both similarities among and clear differences between symptom incidence in the four test conditions. Four items were rated 1 or above in all conditions (68-hungry; 67-felt good; 66-alert; 56-tired), probably reflecting both the arousing aspects and endurance demands of being involved in the project, as well as hunger due to the omission of lunch. The fewest symptoms of any negative severity (ratings of 2 or above on any items except numbers 66, 67 or 68) clearly occurred in the 70°F conditions; the 95°F conditions generated both more symptoms and also different patterns of symptom incidence. One can discern effects probably due to atropine/2-PAM alone (high ratings on 49-dry mouth and 55-thirsty, and a moderate rating on 50-sore throat). Note also that 55-thirsty was rated high in all three stressful conditions, due no doubt to heat exposure and drug effects. The effects of heat alone are shown by high ratings on Items 30-felt warm, 32-feet sweaty, and 33-sweating all over; and a moderate rating on 55-thirsty). One can also see that the most severe condition of drug combined with heat produced the greatest number of high ratings. Headache (Item 2) and lightheadedness (Item 1) were reported only in this condition. Also reported were heat effects (Items 30 and 33), and occurrence of dry mouth (Item 49) and thirst (Item 55).

Profile of Mood States (POMS)

Separate two-way (temperature x drug) analyses of variance were performed on the individual subject ratings for each of the six POMS scales to identify any significant main effects attributable to the test conditions. The

results of these analyses showed significant main effects for temperature, acting to increase tension ($F(1,14) = 5.36$, $p<.05$) and reduce vigor ($F(1,14) = 5.44$, $p<.05$). A significant main effect due to drug on the vigor scale was also found ($F(1,14) = 19.46$, $p<.01$) to indicate reduced vigor with drug.

Brief Subjective Rating Scale (BSRS)

Separate three-way analyses of variance (temperature x drug x cycle) for repeated measures were conducted on the individual subject ratings for each of the BSRS scales.

On the tiredness scale, significant main effects were found for drug ($F(1,14) = 6.93$, $p<.02$), and for cycle ($F(3,42) = 3.39$, $p<.05$), indicating that under the drug condition the subjects felt more tired than they did under placebo, and that they were least tired during pre-test. A significant temperature x drug interaction ($F(1,14) = 10.26$, $p<.01$) was also found, suggesting further that although the subjects felt equally (slightly) tired in the 70°F condition under both drug and placebo, they felt more tired in the 95°F condition under drug (mean rating = 2.5) than under placebo (mean rating = 1.8).

On the discomfort scale, significant main effects were found for temperature ($F(1,14) = 45.16$, $p<.001$), cycle ($F(3,42) = 3.66$, $p<.02$), and for a temperature x cycle interaction ($F(3,42) = 4.17$, $p<.02$), indicating that the subjects felt more uncomfortable at 95°F than at 70°F; also, that their levels of discomfort increased progressively with continued exposure. A significant main effect was also found for drug ($F(1,14) = 8.37$, $p<.02$), indicating that they felt more uncomfortable under the drug-related conditions than under placebo.

On the warmth scale, a large significant main effect was found for

temperature ($F(1,14) = 67.04$, $p<.001$), and for the temperature x cycle interaction ($F(3,42) = 9.81$, $p<.001$), reflecting the overall continuing effect of heat exposure on thermal sensation, despite the lack of corresponding significance of the cycle effect itself.

In general, the BSRS data show that the subjects felt more uncomfortable and more tired under the drug than under the placebo conditions. At 95°F, they felt hot and uncomfortable, as one should expect, and subjective feelings of tiredness were significantly increased by the drug.

The overall results of Study 1 indicate that 2 mg atropine combined with 600 mg 2-PAM had significant but only moderate effects on the subjective feelings, mood states and temperament patterns of the subjects. When combined with heat exposure, however, the drug reactions were intensified beyond those noted under comfortable conditions. The observed effects can be reasonably attributed to heat exposure and omission of lunch, but were not severe enough to seriously interfere with performance. The ESQ, POMS and BSRS inventories effectively reflected the moderate changes which occurred in subjective reactions due to the drugs, and were able to realistically categorize subjective reponses to both drug and heat stress.

Study 2. Effects of Atropine/2-PAM and Heat on Symptomatic, Mood and Subjective Reactions While Wearing the MOPP-IV Ensemble

Method

Subjects

Eight male soldier volunteers not used previously in Study 1, ages 18-22, were screened as described above. They were also briefed, and signed a volunteer agreement of informed consent.

Procedure

Study 2 used the same procedures as Study 1, except that throughout all training and testing the subjects wore the complete MOPP-IV ensemble (including charcoal impregnated jacket and trousers, overboots, mask, hood and gloves), over the BDU system. In order to offset the additional heat load due alone to wearing the MOPP-IV system, the ambient temperature of the no-heat control condition was reduced to 55°F/30%RH (from 70°F/30%RH used in Study 1).

Results and Discussion

The overall stress effects of the test conditions involving 95°F in this study proved so severe that only one subject was able to complete Cycle 2, and no one was able to begin Cycle 3. This contrasts sharply with Study 1, in which all subjects completed all conditions when wearing only BDU's.

Environmental Symptoms Questionnaire (ESQ)

The overall incidence of reported symptoms on the ESQ was surveyed in the same manner as for Study 1, except that the group means for the 55°F/placebo condition arrayed in descending magnitude were used as the optimum basis for comparison, instead of those for the 70°F/placebo condition. The group mean ratings for the four test conditions are summarized in Table 2, along with short statements of the respective items. Note that Table 2, in similar fashion to Table 1, lists only mean item ratings of 1.00 or more for the three stressful conditions being compared to 55°F/placebo. Thus, Table 2 and Table 1 are parallel representations of the ESQ data for the MOPP-IV and BDU conditions, respectively.

Insert Table 2 about here

A comparison of Tables 2 and 1 shows that under the same testing conditions subjects reported many more symptoms while wearing MOPP-IV than they did while wearing BDUs. This clearly demonstrates that wearing MOPP-IV by itself resulted in significant adverse subjective and symptomatic reactions.

Inspection of Table 2 indicates high ESQ ratings on items which reflect symptoms traditionally attributed to atropine (e.g., items 49-dry mouth, 55-thirsty). Some visual symptoms (items 6-dim vision, 40-eyes irritated, 41-blurry vision) were also reported, with highest ratings mainly in test conditions involving drug. Headache was prominent under the heat conditions. Other heat effects are evidenced by high ratings on additional items (30-felt warm, 32-feet sweating, 33-sweating all over). Symptoms probably associated with upper nervous system effects occurred both under drug and heat exposure (items 1-lightheaded, 4-dizzy, 5-faint). The severity of the drug and/or heat effects under MOPP-IV is evident in the high number of body discomfort symptoms (items 13-chest pain, 15-hands shaking, 16-muscle cramps, 17-stomach cramps, 18-muscles stiff/tight, 21-hands/arms/shoulders ache, 22-back ache, 23-stomach ache, 31-feverish, 50-sore throat, 51-coughing, 53-felt sick, 56-tired). General negative feeling and mood reactions were also frequent during the MOPP-IV conditions (items 7-coordination off, 56-tired, 61-worried, 62-irritable, 63-restless, 64-bored). Hunger feelings were reported again (item 68), probably due once more to the omission of lunch.

Profile of Mood States (POMS)

The individual subjective ratings on the POMS were collated, and separate two-way analyses of variance for repeated measures were then conducted on each of the scales. The results of these analyses indicated significant main effects due to drug for tension ($F(1,7) = 7.06$, $p<.05$), and for depression

($F(1,7) = 7.08$, $p<.05$). Significant main effects due to temperature were obtained for tension ($F(1,7) = 20.59$, $p<.01$), depression ($F(1,7) = 11.05$, $p<.02$), fatigue ($F(1,7) = 13.35$, $p<.01$), and confusion ($F(1,7) = 6.57$, $p<.05$). Significant drug x temperature interactions were also obtained for depression ($F(1,7) = 10.75$, $p<.02$) and confusion ($F(1,7) = 11.53$, $p<.02$). Thus, the drug led to feelings of tension and depression; heat led to feelings of tension, depression, fatigue and confusion; and the heat/drug condition resulted in the highest incidence of depression and confusion.

Brief Subjective Rating Scale (BSRS)

The individual subjective ratings on the BSRS were collated, and separate three-way analyses of variance for repeated measures were then conducted on each of the scales. The results of these analyses indicated a significant main effect of drug on tiredness ($F(1,7) = 87.62$, $p<.001$); also, significant main effects of temperature on tiredness ($F(1,7) = 5.91$, $p<.05$), discomfort ($F(1,7) = 155.68$, $p<.001$), and warmth ($F(1,7) = 112.87$, $p<.001$). A significant drug x temperature interaction was obtained for warmth ($F(1,7) = 6.38$, $p<.05$). In addition, the effects of continued heat exposure were reflected by significant effects for cycle on the tiredness scale ($F(3,21) = 17.67$, $p.001$), and the discomfort scale ($F(3,21) = 17.52$, $p.001$). These were coupled with significant temperature x cycle interactions (($F(3,21) = 16.60$, $p.001$) for the tiredness scale, and ($F(3,21) = 8.94$, $p<.001$) for the discomfort scale).

The overall findings of Study 2 indicate that the much greater heat load generated by wearing the impermeable MOPP-IV ensemble oriented the subjects' symptomatic reactions toward the excessive heat conditions, as well as toward the effects of the drugs. The significant reactions of tiredness and

discomfort were consistent with the responses to heat, and are what one would expect with continued exposure to those stress conditions.

To get some indication of the subjective reactions of the subjects during the period prior to their removal from the study, an additional analysis of the BSRS data for Cycle 1 was also performed. The ESQ and POMS could not be included in this analysis, since they were administered only once at the end of each test day. The results of these analyses showed significant main effects due to temperature both on the warmth scale ($F(1,7) = 37.19$, $p<.001$), and on the discomfort scale ($F(1,7) = 79.55$, $p<.001$). These findings indicate that the subjects were developing early symptomatic reactions to the heat conditions even in Cycle 1 while otherwise still operational, and correspond to the later more severe heat reactions which occurred in Cycle 2.

Table 3 summarizes the individual exposure duration times and symptoms of the subjects in Study 2 who either voluntarily withdrew or were removed. It can be seen that in both conditions involving heat, half of the subjects voluntarily withdrew, and the other half were removed by the medical monitor. Note also that the majority of these cases were due to signs and symptoms of impending heat illness. Furthermore, the exposure times in the heat/drug condition (Mean = 149.25 minutes; SD = 39.93) were considerably shorter than in the heat/placebo condition (Mean = 183.62 minutes; SD = 29.74). The difference between these group mean endurance times was found to be highly significant, based on a Student's t test for paired data ($t(7) = 3.11$, $p<.02$). Thus, it appears that although the overall effects of drug were secondary to those of heat in this study, one dose of atropine/2-PAM still effectively reduced the endurance times of the subjects when potentiated by severe heat combined with MOPP-IV. In contrast, only one withdrawal occurred during the

55°F conditions, and this case was judged by the medical monitor to be probably due to hypoglycemia.

There was only one incident in this study of hyperventilation due to heat, and there were no anxiety attacks or claustrophobic reactions, such as those reported by Brooks, Xenakis, Ebner, and Balson (1983). This is counter to concerns expressed by Brooks et al. about possible encapsulation effects due to the use of the MOPP-IV system, based on their findings in a field training exercise (FTX) requiring soldiers to wear MOPP-IV gear for only one hour. Despite that short time period, three of 70 soldiers (4.3%) had to be removed within the first 10 minutes due to negative psychological reactions (anxiety, panic, hyperventilation, visual distortions, and fear of dying), and at least 20% of the participants showed 'negative psychological reactions as manifested by gross symptoms' which required intervention by study personnel. Carter and Cammermeyer (1985a) reported a similar attrition rate in another field study requiring soldiers to wear MOPP-IV for 2.5 hours. In that study, five out of 105 soldiers (4.8%) dropped out because of hyperventilation, claustrophobia, headache, dizziness, inability to tolerate the mask, confusion of time judgment, and tremors. However, in a later three-day field study involving soldiers wearing MOPP-IV, Carter and Cammermeyer (1985b) obtained results which did not correspond either to their own previous findings or to those of Brook. et al., in that only five out of 195 soldiers (2.6%) had to be removed. Furthermore, none of the five had to be removed until the evening of the second day, each one a heat casualty. In contrast, no extreme psychological reactions or anxiety attacks were observed in the present study, even though symptoms of heat illness occurred in Study 2, and no one was able to complete six hours of heat exposure while in MOPP-IV gear. Therefore, we

conclude that the reactions observed both by Brooks et al., and by Carter and Cammermeyer are probably rare occurrences. Nevertheless, this area needs further study, especially since others (Gorman et al, 1988; Morgan, 1983) have cited evidence that wearing gas masks may trigger disordered breathing and panic reactions in individuals who possess certain personality attributes.

Summary

In two studies of subjective reactions to exposure to ambient heat (95°F, 60%RH) and a single dose of nerve agent antidote (2 mg atropine sulfate; 600 mg 2-PAM chloride), it was found that:

(1) In ambient heat, all subjects were able to complete six hours of testing when wearing BDUs, but only two hours when dressed in MOPP-IV chemical protective clothing.

(2) Reported symptoms were due primarily to ambient heat rather than to the antidote.

(3) Elevated heat stress caused by wearing the MOPP-IV ensemble in ambient heat significantly increased the frequency and severity of reported symptoms compared to equivalent conditions while wearing only BDUs.

(4) Effects of atropine/2-PAM were potentiated by severe heat combined with MOPP-IV, resulting in significantly shorter endurance times.

(5) Claustrophobic and anxiety reactions due to encapsulation in MOPP-IV as reported in other studies were not observed under any of the conditions tested.

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TABLE 1

SUMMARY OF GROUP MEAN RATINGS ON ESQ ITEMS FOR EACH EXPERIMENTAL CONDITION RANK ORDERED ACCORDING TO RATINGS IN THE 70°F/PLACEBO CONDITION - BDU

ITEM NO.	DESCRIPTION OF ITEM	GROUP MEAN RATINGS 70°/Pl.	70°/Dr.	95°/Pl.	95°/Dr.
68	I was hungry	3.40	3.00	3.27	2.87
67	I felt good	2.73	1.60	1.93	1.20
66	I felt alert	2.13	1.47	2.20	1.33
56	I felt tired	1.20	1.07	1.00	1.87
57	I felt sleepy	0.93	1.20		1.93
36	I felt chilly	0.93	1.07		
35	My feet were cold	0.80			
34	My hands were cold	0.80			
37	I was shivering	0.53			
25	I had gas pressure	0.53			
7	Coordination was off	0.47			
51	I was coughing	0.40			
49	My mouth was dry	0.40	3.53		3.27
1	I felt lightheaded	0.40			1.07
2	I had a headache	0.33			2.13
19	I felt weak	0.33			
64	I was bored	0.33			
47	I had a runny nose	0.33			
50	My throat was sore	0.27	1.20		
4	I felt dizzy	0.20			
20	My legs or feet ached	0.20			
6	My vision was dim	0.20			
46	My nose felt stuffed up	0.20			
59	Concentration was off	0.20			
29	Urinate less than usual	0.20			
17	I had stomach cramps	0.20			
40	My eyes felt irritated	0.20			
60	Was more forgetful	0.20			
23	I had a stomach ache	0.20			
39	Skin burning or itchy	0.13			
41	My vision was blurry	0.13			
53	I felt sick	0.13			
63	I felt restless	0.13			
61	Felt worried/nervous	0.13			
22	My back ached	0.13			
55	I was thirsty	0.13	2.73	1.07	2.27
13	I had a chest pain	0.13			
45	My ears were ringing	0.13			
24	Felt sick to stomach	0.13			
62	I felt irritable	0.07			
18	Muscles tight or stiff	0.07			
52	I lost my appetite	0.07			

TABLE 1 (CONTINUED)

SUMMARY OF GROUP MEAN RATINGS ON ESQ ITEMS FOR EACH EXPERIMENTAL CONDITION RANK ORDERED ACCORDING TO RATINGS IN THE 70°F/PLACEBO CONDITION - BDU

ITEM NO.	DESCRIPTION OF ITEM	GROUP MEAN RATINGS 70°/Pl.	70°/Dr.	95°/Pl.	95°/Dr.
21	Hand/arm/shoulder ache	0.07			
15	Hands shaking-trembling	0.07			
30	I felt warm	0.07		3.07	2.40
5	I felt faint	0.07			
42	Ears blocked up	0.07			
38	Parts of body numb	0.07			
32	Feet were sweaty	0.07		2.00	
16	I had a muscle cramp	0.07			
3	I felt sinus pressure	0.07			
44	I couldn't hear well	0.07			
27	I felt constipated	0.00			
31	I felt feverish	0.00			
48	I had a nose bleed	0.00			
14	I had chest pressure	0.00			
12	Heart was pounding	0.00			
11	Heart was beating fast	0.00			
10	It hurt to breathe	0.00			
9	It was hard to breathe	0.00			
8	I was short of breath	0.00			
54	I felt hung over	0.00			
33	Sweating all over	0.00		3.40	3.13
65	I felt depressed	0.00			
43	My ears ached	0.00			
28	Urinate more than usual	0.00			
26	I had diarrhea	0.00			
58	I couldn't sleep well	0.00			

Note: Only ratings of 1.00 or greater are shown for the 70°F/Drug, 95°F/Placebo, and 95°F/Drug conditions

TABLE 2

SUMMARY OF GROUP MEAN RATINGS ON ESQ ITEMS FOR EACH EXPERIMENTAL CONDITION RANK ORDERED ACCORDING TO RATINGS IN THE 55°F/PLACEBO CONDITION - MOPP-IV

ITEM NO.	DESCRIPTION OF ITEM	GROUP MEAN RATINGS 55°/Pl.	55°/Dr.	95°/Pl.	95°/Dr.
68	I was hungry	3.25	2.75	2.12	2.50
67	I felt good	2.62	2.00	1.50	
66	I felt alert	2.37	2.25	2.50	2.12
57	I felt sleepy	1.87	2.87	1.00	2.37
56	I felt tired	1.62	2.87	1.12	2.50
34	My hands were cold	1.00			
22	My back ached	0.87	1.25		1.87
7	Coordination was off	0.87	1.00	1.50	1.62
64	I was bored	0.75	1.25		
36	I felt chilly	0.75			
2	I had a headache	0.75		3.37	2.87
44	I couldn't hear well	0.75			1.00
51	I was coughing	0.75			1.12
49	My mouth was dry	0.62	4.12		3.87
12	Heart was pounding	0.62		2.50	2.00
30	I felt warm	0.62		4.00	3.25
59	Concentration was off	0.62			1.62
55	I was thirsty	0.62	2.62	1.87	4.00
46	My nose felt stuffed up	0.50			
62	I felt irritable	0.50			1.50
58	I couldn't sleep well	0.50			
63	I felt restless	0.37		1.25	1.62
16	I had a muscle cramp	0.37	1.75		2.25
29	Urinate less than usual	0.37			
35	My feet were cold	0.37			
20	My legs or feet ached	0.37	1.12		2.25
50	My throat was sore	0.37	1.37		1.37
41	My vision was blurry	0.25	1.87	1.00	2.50
4	I felt dizzy	0.25	1.00	2.12	2.25
18	Muscles tight or stiff	0.25	1.50		2.00
11	Heart was beating fast	0.25		2.50	2.25
9	It was hard to breathe	0.25		2.50	2.62
47	I had a runny nose	0.25		1.50	
6	My vision was dim	0.25	1.37		1.87
3	I felt sinus pressure	0.25			
60	Was more forgetful	0.25			1.25
1	I felt lightheaded	0.25		1.50	2.50
15	Hands shaking-trembling	0.25		1.00	1.37
40	My eyes felt irritated	0.25		1.62	2.12
61	Felt worried/nervous	0.25			1.00
28	Urinate more than usual	0.12			
65	I felt depressed	0.12			
45	My ears were ringing	0.12			

TABLE 2 (CONTINUED)

SUMMARY OF GROUP MEAN RATINGS ON ESQ ITEMS FOR EACH EXPERIMENTAL CONDITION RANK ORDERED ACCORDING TO RATINGS IN THE 55°F/PLACEBO CONDITION - MOPP-IV

ITEM NO.	DESCRIPTION OF ITEM	GROUP MEAN RATINGS 55°/Pl.	55°/Dr.	95°/Pl.	95°/Dr.
25	I had gas pressure	0.12			
32	My feet were sweaty	0.12		2.25	2.25
8	I was short of breath	0.12		2.62	2.37
33	Sweating all over	0.12		4.37	4.00
26	I had diarrhea	0.00			
37	I was shivering	0.00			
19	I felt weak	0.00		1.75	2.00
39	Skin burning or itchy	0.00			
17	I had stomach cramps	0.00		1.00	1.37
27	I felt constipated	0.00			
24	Felt sick to stomach	0.00		1.25	2.37
14	I had chest pressure	0.00			
13	I had a chest pain	0.00		1.25	
42	Ears blocked up	0.00			
43	My ears ached	0.00			
10	It hurt to breathe	0.00			
38	Parts of body numb	0.00			
21	Hand/arm/shoulder ache	0.00			1.00
23	I had a stomach ache	0.00		1.00	1.75
48	I had a nose bleed	0.00			
5	I felt faint	0.00		1.37	1.62
52	I lost my appetite	0.00			
53	I felt sick	0.00		1.00	2.50
54	I felt hungover	0.00			
31	I felt feverish	0.00		1.00	1.50

Note: Only ratings of 1.00 or greater are shown for the 55°F/Drug, 95°F/Placebo, and 95°F/Drug conditions

TABLE 3

EXPOSURE DURATIONS AND SYMPTOMS OF SUBJECTS
WHO WITHDREW OR WERE REMOVED - MOPP-IV

Exposure Time (Minutes)	Withdrew/ Removed	Symptoms
95 Degrees, Placebo (8 of 8 withdrew/removed)		
236	Removed	Rectal temperature criteria exceeded
198	Withdrew	Dizzy, severe nausea
194	Removed/ Withdrew	Chest pressure, heart pounding, felt 'really weird'
190	Removed/ Withdrew	Dizzy, heart pounding (high heart rate)
186	Withdrew	Headache, dizzy, stomach cramps
185	Removed	Hyperventilating
149	Withdrew	Severe headache (head 'exploding')
131	Withdrew	Couldn't breathe, 'lungs bursting'
Mean = 183.62 Standard Deviation = 29.74		
95 Degrees, Atropine + 2-PAM (8 of 8 withdrew/removed)		
252	Removed	Rectal temperature criteria exceeded
156	Removed	Heart rate criteria exceeded
137	Withdrew	Too hot, felt about to hyperventilate
135	Withdrew	Headache, dizzy, lightheaded, felt sick to stomach
134	Removed	Heart rate criteria exceeded
130	Withdrew	Specific reason unclear, unsteady
128	Withdrew	Headache, dizzy, lightheaded, felt sick to stomach
122	Removed/ Withdrew	Unsteady (assistance needed), dizzy, dozing off during tests
Mean = 149.25 Standard Deviation = 39.93		
55 Degrees, Atropine + 2-PAM (1 of 8 withdrew/removed)		
241	Removed	Dizzy, chilly, feeling 'woozy' (suspected hypoglycemia)

Acknowledgement

We would like to express our thanks and appreciation to Dr. Margaret A. Kolka, MAJ Paul Rock and MAJ Katy Reynolds for medical and scientific support, and to SGT Douglas Dauphinee, Ms Alyssa Terry and Mr. William Tharion for their invaluable support and assistance in data collection and statistical analysis.

Disclaimer Statement

1. The views, opinions and/or findings contained in this report are those of the author(s), and should not to be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.

2. Human subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Regulation 70-25 on Use of Volunteers in Research.

Index Terms:

Drug

Heat

Atropine

Pralidoxime

2-PAM chloride

Chemical protective clothing

MOPP

BDU

Mood

POMS

ESQ

BSRS